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THE IMPACT OF THE OIL SPILL OF THE TANKER "ARAGON" ON THE LITTORAL FISH FAUNA OF PORTO SANTO (NE ATLANTIC OCEAN) IN 1991 AND TEN YEARS LATER *

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With 2 figures and 3 tables

RESUMO. Em Janeiro de 1990, a Ilha de Porto Santo (Arquipélago da Madeira), foi atingida por uma maré negra proveniente de um derrame do navio petroleiro "Aragon". Um ano depois, avaliou-se a ictiofauna costeira. Dez anos depois da maré negra, uma nova amostragem foi realizada com a mesma metodologia, de forma a comparar com os dados recolhidos anteriormente. A análise dos resultados obtidos parece revelar que os efeitos da maré negra nos peixes litorais foram reduzidos. Este trabalho constitui a primeira contribuição para a "check-list" da ictiofauna costeira da Ilha de Porto Santo.

PALAVRAS CHAVE: Peixes, censos visuais, maré negra, Porto Santo, NE Oceano Atlântico.

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ABSTRACT. In January 1990, the tanker "Aragon" oil spill reached Porto Santo Island (Madeira Archipelago). One year later, in 1991 the littoral fish fauna was evaluated. Ten years after the "Aragon" oil spill, a new survey was made using the same methods, to compare data. From the results it seems that the effects of the oil were rather small. As a result of this work, as a check-list of the littoral fish fauna of this Island is presented.

KEY WORDS: Pisces, visual census, oil spill, Porto Santo, NE Atlantic Ocean.

INTRODUCTION

The island of Porto Santo is the second island largest of the archipelago of Madeira and is located 45 miles northeast of Madeira proper, in the north-eastern Atlantic Ocean, between 32º 59' / 33º 07' N and 16º 16' / 16º 24' W.

On December 1989, the Spanish oil tanker "Aragon" who was passing NE Madeira Archipelago, suffered engine failure in mountainous seas. As a consequence of this, damage occurred in one of the ship's tanks and some 15,000 tons of crude oil were spilled, the first slicks hitting the coast of Porto Santo on January 1990 (BISCOITO & ZINO, 1990). The northeast and eastern coast of Porto Santo (Fig. 1) were the most affect ones (ARAÚJO, 1992).

Until the "Aragon" oil spill few works have been done on the ichthyofauna of Porto Santo. The few references to fishes of this island are given by NORONHA & SARMENTO (1948) and NUNES (1974).

In order to make a preliminary assessment of the damage caused by oil on the ecosystem, an evaluation of the littoral fish fauna was done in May 1991 (ALMEIDA & ARAÚJO, 1991). Ten years after the "Aragon" oil spill a new survey was made using the same methods. The results obtained and a comparison with the 1991 data is given hitherto.

MATERIAL AND METHODS

The sampling collection was carried out in 1991 and again in 2000. The evaluation of the pelagic, bentho-pelagic and benthic ichthyofauna was done by:

1. Scuba diving observations (visual census);
2. Sampling collections with a beam trawl over sandy bottoms;
3. Sampling collections in intertidal zones.

The stations were chosen according to the potential influence of oil spill. The locations choosed were (Fig. 1): Zimbralinhos (west coast, rocky bottom) and Lages (northwest coast, rocky bottom), not affected by the oil spill; Serra de Fora – Prainha, Serra de Dentro (east coast, rocky bottom), heavily affected by the oil spill; and Cais

da Vila Baleira-Ponta do Passo (southwest coast, sandy bottom) affected partially by the oil spill.

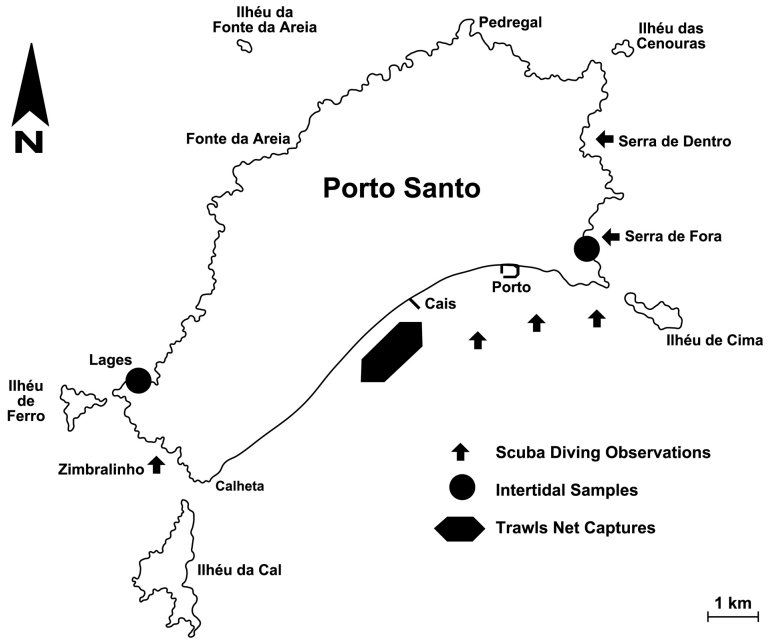

Fig. 1 - Porto Santo Island: Sites of observation and capture of fish fauna.

Scuba diving observations were carried following the method devised by HARMELIN-VIVIEN & HARMELIN (1975), in order to identify and evaluate the local fish fauna at three different locations, chosen according to the potential influence of oil spill. Diversity indices (Shannon and Evenness) for visual census were calculated according to MAGURRAN (1988).

Sampling was performed using a small bean trawl over sandy bottoms (depth -15/ -10 m). The beam trawl used had a length of 4 m, a mouth aperture of 1,5 x 0,5 m and a mesh aperture of 1 cm.

The intertidal fish fauna was evaluated in two localities: Serra de Fora – Prainha (affected zone) and Lages (unaffected zone) using small hand nets.

RESULTS

1. Visual Census

Results of the observations carried by scuba diving are shown in Table 1. A total of 41 different species were observed in both years. In Zimbralinho and Serra de Fora – Prainha, the number of species increased in 2000, while in Serra de Dentro the number of species remained the same.

TABLE 1 - Observed species by scuba diving in the three stations: (•) present 1991; (+) present 2000.

		Zimbralinho		Serra de Fora		Serra de Dentro	
FAMILY	**SPECIES**	**1991**	**2000**	**1991**	**2000**	**1991**	**2000**
APOGONIDAE	*Apogon imberbis* (Linnaeus,1758)		+	•		•	
BALISTIDAE	*Balistes capriscus* Gmelin,1789			•			
BLENNIIDAE	*Ophioblennius atlanticus* (Valenciennes,1836)	•	+				
BOTHIDAE	*Bothus podas* (Delaroche, 1809)		+				
CARANGIDAE	Spp.			•			
CONGRIDAE	*Heteroconger longissimus* Günther,1870		+		+		
DASYATIDAE	*Dasyatis pastinaca* (Linnaeus,1758)				+	•	
GADIDAE	*Phycis phycis* (Linnaeus,1766)			•	+		
GOBIIDAE	*Gobius paganellus* Linnaeus,1758		+				
	Pomatoschistus pictus (Malm,1865)	•	+				
	Thorogobius ephippiatus (Lowe,1839)					•	
KYPHOSIDAE	*Kyphosus sectator* (Linnaeus,1766)				+		
LABRIDAE	*Centrolabrus trutta* (Lowe,1834)	•	+				+
	Symphodus sp.	•				•	
	Thalassoma pavo (Linnaeus,1758)	•	+	•	+	•	+
	Xyrichthys novacula (Linnaeus,1758)		+		+		+
LABRISOMIDAE	*Labrisomus nuchipinnis*						
	(Quoy & Gaimard, 1824)		+				
MULLIDAE	*Mullus surmuletus* Linnaeus,1758		+		+		
MURAENIDAE	*Muraena augusti* Kaup, 1856		+				
	Muraena helena Linnaeus,1758			•		•	
MYLIOBATIDAE	*Myliobatis aquila* (Linnaeus,1758)						+
POMACENTRIDAE	*Abudefduf luridus* (Cuvier,1830)	•	+	•	+	•	+
	Chromis limbata (Valenciennes,1833)	•	+	•	+	•	+
SCARIDAE	*Sparisoma cretense* (Linnaeus,1758)	•	+	•	+	•	+
SCORPAENIDAE	*Scorpaena* sp.	•		•		•	
	Scorpaena maderensis Valenciennes,1833		+		+		+
SERRANIDAE	*Mycteroperca fusca* (Lowe, 1838)				+		+
	Serranus atricauda Günther,1874	•	+			•	+
SPARIDAE	*Boops boops* (Linnaeus,1758)	•	+	•	+	•	
	Diplodus cervinus (Lowe,1838)			•	+		
	Diplodus sargus (Linnaeus,1758)			•	+		+
	Diplodus vulgaris (E.G.Saint-Hilaire,1817)	•		•	+	•	+
	Oblada melanura (Linnaeus,1758)	•			+		+
	Pagellus erythrinus (Linnaeus,1758)				+		
	Pagrus pagrus (Linnaeus,1758)				+		
	Sarpa salpa (Linnaeus,1758)	•		•		•	+
	Spondyliosoma cantharus (Linnaeus,1758)		+				
SYNODONTIDAE	*Synodus saurus* (Linnaeus,1758)	•	+		+		+
TETRAODONTIDAE	*Canthigaster capistratus* (Lowe, 1839)	•	+	•	+	•	+
	Sphoeroides marmoratus (Lowe,1838)	•	+	•	+	•	+
TRIPTERYGIIDAE	*Tripterygion delaisi* Cadenat & Blache,1970	•	+	•		•	
	TOTAL	**18**	**23**	**18**	**22**	**17**	**17**

Diversity indices (Shannon and Evenness) for visual census were calculated and shown in Fig. 2. The value of Shannon-wiener diversity index only increased in the year 2000, in Serra de Dentro, at -5 m depth but in general the values remained the same. Regarding the evenness of species, the values from 1991 to 2000, increased at lower depth (-5 m) in Serra de Fora – Prainha and Serra de Dentro.

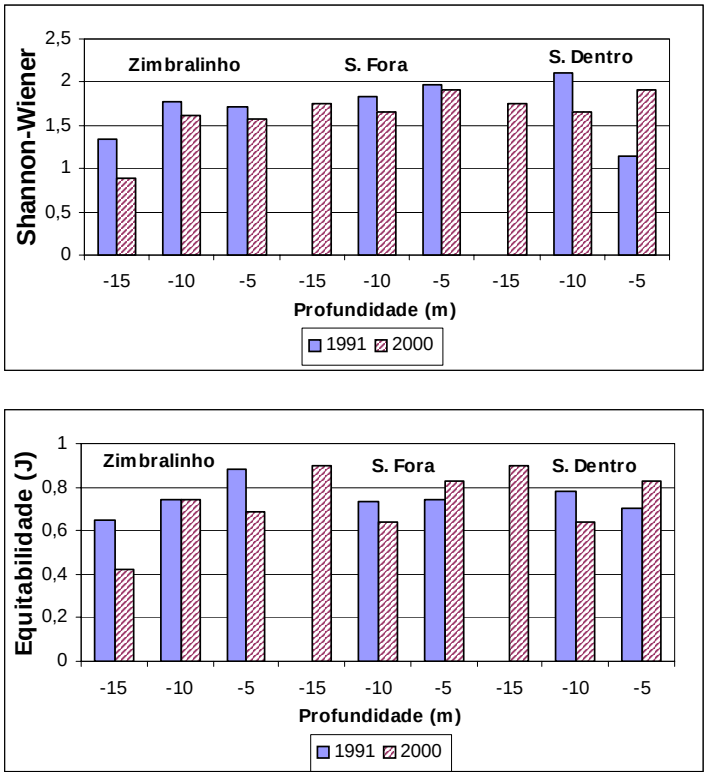

Fig. 2 - Diversity indices calculated for each station.

2. Trawls

Nine species were caught with beam trawl (Table 2). In both years *Bothus podas* (DELAROCHE, 1809), was most numerous, corresponding to about 75% of the captures.

TABLE 2 - Number of individuals captured in Porto Santo beach (South coast).

		Infralitoral zone		
		Day	Day	Night
		1991	2000	1991
FAMILY	SPECIES	4 trawls	3 trawls	3 trawls
BOTHIDAE	*Bothus podas* (Delaroche, 1809)	56	7	32
CONGRIDAE	*Ariosoma balearicum* (Delaroche,1809)			1
LABRIDAE	*Xyrichthys novacula* (Linnaeus,1758)	2	1	
SPARIDAE	*Pagellus bogaraveo* (Brunnich,1768)	1		
SYNODONTIDAE	*Synodus saurus* (Linnaeus,1758)	5	1	1
TETRAODONTIDAE	*Sphoeroides marmoratus* (Lowe,1838)	5		
TORPENIDIDAE	*Torpedo marmorata* Risso,1810	1		
TRACHINIDAE	*Trachinus draco* Linnaeus,1758	2		2
	Trachinus vipera Cuvier,1829	5		1
	TOTAL	77	9	37

3. Intertidal

The collections in the intertidal zone revealed a total presence of 16 species, with the predominance of Blenniidae and Gobiidae (Table 3).

Comparing two stations (Lages and Serra de Fora – Prainha) in terms of total number of species present in the two surveys, the Lages station revealed the presence of 6 species while the Serra de Fora – Prainha Station had 14 species present.

Regarding only Serra de Fora – Prainha station, the number of species increased from 3 species in year 1991 to 13 species in year 2000.

TABLE 3 - Number of specimens captured in the intertidal zone.

		Lages		Serra de Fora	
FAMILY	**SPECIES**	**1991**	**2000**	**1991**	**2000**
BLENNIIDAE	*Coryphoblennius galerita* (Linnaeus,1758)	11	4		2
	Paralipophrys trigloides (Valenciennes,1836)	11	2		7
	Parablennius sanguinolentus (Pallas,1814)	9	7	6	26
GOBIIDAE	*Gobius paganellus* Linnaeus,1758	10		22	9
	Mauligobius maderensis (Valenciennes,1837)		3		3
LABRIDAE	*Thalassoma pavo* (Linnaeus,1758)				20
POMACENTRIDAE	*Abudefduf luridus* (Cuvier,1830)				1
SCORPAENIDAE	*Scorpaena maderensis* Valenciennes,1833				1
SERRANIDAE	*Epinephelus marginatus* (Lowe, 1834)		1	1	
SPARIDAE	*Diplodus vulgaris* (E.G.Saint-Hilaire,1817)				1
	Sarpa salpa (Linnaeus,1758)				4
	Spondyliosoma cantharus (Linnaeus,1758)				7
TETRAODONTIDAE	*Sphoeroides marmoratus* (Lowe,1838)				1
TRIPTERYGIIDAE	*Tripterygion delaisi* Cadenat & Blache,1970				1
	TOTAL	**41**	**17**	**29**	**83**

DISCUSSION

The few existent data gathered before the oil spill, do not allow us to state and even know the littoral fish fauna of Porto Santo Island. A part of this work is meant to contribute to the knowledge of the littoral fish fauna of this Island.

From the results, the only relevant fact that we have observed is a large increase of intertidal species in Serra de Fora – Prainha that may indicate a recover of a zone affected by the oil spill. Nerveless, caution should be taking, since the effort in different stations (Lages and Prainha) was not the same, especially in 2000, when we did an extra effort regarding Prainha station.

It is well known that the toxic effect of an oil spill for the littoral ichthyofauna seems to be low (LASSUS *et al*., 1982). Since the main area contaminated by oil were a rocky shore, the effect tend to be low because rocky shores are high-energy beaches and

stranded oil is quickly removed from the intertidal region by wave action and water movement (CLARK, 1992).

In resume, it seems that the effects of the oil were rather small, and the littoral fish fauna is recovered, with an increase of intertidal species in the area more affected by the oil spill.

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